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HISTORY OF FOREST INSECT PROBLEMS
YELLOWSTONE NATIONAL PARK

SUBJECT-

INDEX No.-

HISTORY OF FOREST INSECT PROBLEMS YELLOWSTONE NATIONAL PARK

INTRODUCTION

This history presents a brief summary of all known forest insect infestations within the Yellowstone National Park. Data from correspondence, field notes, published and unpublished manuscripts have been used in its compilation, to which proper reference is made. Although this information dates back to 1923 only, it is rather complete and has permitted an accurate depiction of all reported situations.

Mixed forest types, with each tree species having its own insect enemies, present a varied list of insect problems. This is especially true of timber stands in National Park forests, which are left to natural processes of regeneration; where trees mature, die, and are replaced by the same or other tree species. In such forests during a natural transition of forest types secondary insects often become destructive due to the reduced resistance of old, overmature trees.

Available records indicate that in 1923 a representative of the Forest Insect Laboratory of the Bureau of Entomology and Plant Quarantine at Coeur d'Alene, Idaho, was the first forest entomologist to work officially in the Yellowstone National Park. Dr. A. D. Hopkins and associates attended a meeting of National Park Superintendents in September 1911. Dr. H. M. Burke, Associate Entomologist, Forest Insect Laboratory, Palo Alto, Calif., spent the field seasons of 1925-27 inclusive in studying existing insect problems. With the exception of these three years the Coeur d'Alene Laboratory has been closely connected with all entomological activities within the Yellowstone National Park.

The forest insect situations summarized in this manuscript are listed under the year they were first reported, with the years in chronological order. Although all irrelevant material has been omitted from each summary, detailed information concerning each situation is on file with the National Park Service, Yellowstone National Park, and the Bureau of Entomology and Plant Quarantine, Forest Insect Laboratory, Coeur d'Alene, Idaho. Complete indices have been prepared and proper references made to all material used.

1923

Insect - Spruce budworm (Cacoecia fumiferana)
Hosts - Douglas fir and Engelmann spruce
Location - Yellowstone River, Blacktail Deer Creek to Garnet Hill
Associated insect - Douglas fir beetle (Dendroctonus pseudotsugae Hopk.)

From the appearance of the timber stand this epidemic of the spruce budworm started some few years previous near the mouth of Blacktail Deer Creek (13). At the time of the examination the insects had spread eastward up the Yellowstone River for a distance of 8 or 10 miles to a point between Garnet and Crescent Hills. The infested area included all of the side drainages, with severe damage extending up the rather large Hellroaring Creek drainage for a distance of several miles.

It was estimated that throughout the infested area, which was stocked with mature Douglas fir and Engelmann spruce, approximately 8 percent of the trees had already been killed. This loss varied from no visual damage in some areas to heavy spot kills of timber on one hundred acres or more. The damage was most severe along stream bottoms in moderately open timber stands, and rose slowly toward the higher elevations of the mountain sides. Throughout the area the entire stand was infested with the exception of trees in openings, which in many instances had escaped. Both Douglas fir and Engelmann spruce were attacked, with the first-named species being the preferred host.

In 1924 the severity of the damage had materially increased (14). At that time it was estimated that at least 50 percent of the Douglas fir trees had been killed. The defoliation was most severe in stands of pure Douglas fir, and on some relatively large areas practically every tree had been killed. Although the timber losses were heaviest on the flats and rolling hills along the floor of the valley, they extended up all tributary streams and on the mountain sides to rather definite elevations. No definite explanation for these elevational limits of infestation were given. Temperatures unfavorable to the development of overwintering larvae or the effects of air currents upon the flights of adult moths were offered as possible explanations. The defoliation which occurred in 1924 was apparently the last of this outbreak, for the following season there was no evidence of defoliation and only a few adult moths were observed in flight (6, 7).

Throughout the infested area thousands of Douglas fir trees that had been defoliated were attacked by the Douglas fir beetle (14). Although these attacks were secondary to the budworm defoliation, they caused the death of many trees which would have otherwise recovered. At that time (1924) it was feared ~~that the tremendous beetle population~~ that the tremendous beetle population that was developing in the defoliated trees would, when this supply of host material was exhausted, spread into uninfested timber stands adjacent (15). Although there was some loss of nondefoliated timber, it was not at all serious and no control measures were necessary (16).

1923

Insect - Douglas fir beetle
Host - Douglas fir
Location - Camp Roosevelt

In the forest immediately adjacent to Camp Roosevelt a potentially serious infestation of the Douglas fir beetle was recorded in 1923 (6,13,14).

This outbreak was considered as having originated from Douglas fir slash associated with the cutting of logs for the construction of the Camp Roosevelt Lodge in 1919. Because of the scenic value attached to the trees of this area artificial control measures were recommended. Unfortunately this work was not properly conducted and the following season there was a marked increase in the severity of the outbreak. Artificial control measures were instituted again in 1924 which were considered as successful. Although a few infested trees were found subsequently within the area, no further control was necessary (16).

1924

Insects - Lodgepole sawfly (Neodiprion burkei Midd.)
Lodgepole pine needle tier (Argyrotaenia pinatubana)

Host - Lodgepole pine

Location - West Yellowstone

In 1924 it was found that for two or three years there had been a severe epidemic of the lodgepole pine sawfly and lodgepole pine needle tier in the vicinity of West Yellowstone (14). The combined attacks of these two insects had destroyed practically all of the lodgepole pine on some 12,000 acres of forest land within the Yellowstone National Park and Madison National Forest adjacent. The total infested area was approximately 60,000 acres; however, on some 45,000 acres the infestation was not at all severe and but little damage resulted (9). Actual losses were confined to heavy pure stands of second growth lodgepole pine which varied from 20 to 30 feet in height. The larger trees, remnants of the original stand which was destroyed by fire some 50 years previous, had escaped severe defoliation.

At the time this area was examined (July 1924) the timber stands along the Park road at West Yellowstone were heavily infested (6, 7, 14). As this insect outbreak threatened to destroy the scenic values of these areas, plans were made for the immediate institution of artificial control. A high-power sprayer was obtained from the Bureau of Entomology and Plant Quarantine at Boston, Mass., and a strip of timber about 150 feet wide on each side of the main highway between West Yellowstone and Madison River bridge was sprayed. The first year only 5 miles of highway was covered by this operation, but during the following three seasons 7½ miles were treated (9). This project was entirely successful in destroying the insect on the treated trees, which however were reinfested each year from the untreated areas adjacent. The severity of this outbreak was at its peak in 1924 and there was not a great deal of damage subsequent to that time.

In considering the interrelation of these two insects some question existed as to the primary or most destructive species. Although the sawfly outbreak subsided in 1925 and 1926, the needle tier infestation

persisted and is still present in this and other park areas, where it causes no serious damage. This would seem to indicate that the sawfly was the most destructive of these two insects. Heavy attacks of the needle tier do not destroy a large percentage of the tree's foliage, so that timber stands apparently resist its attacks.

In 1936 indications of a repetition of the former outbreak of these insects was reported. An examination showed no marked change from the past status of the needle tier infestation, although there had been some feeding by sawfly larvae on a few trees the previous season (19). This situation was watched during the next few years, but nothing serious developed.

In 1940 a severe infestation of the lodgepole needle tier was recorded in the area along the old Mesa road south of Madison Junction (24). The lodgepole pine trees in this area are small and the stand is not in a healthy condition, which no doubt explains the apparent serious effects of the attacks of this insect. There are many dead and dying trees in this area.

1924

Insect -- Engelmann spruce beetle (Dendroctonus engelmanni Hopk.)

Host - Engelmann spruce

Locality - Frank Island and adjacent east shore of Yellowstone Lake

The occurrence of large volumes of dead spruce on Frank Island, Yellowstone Lake, and along the adjacent east shore was reported in 1924. An examination of this mixed forest type showed that 60 to 70 percent of the spruce had been killed during the past five years by the Engelmann spruce beetle (14). Although detailed data were not obtained, it was estimated that the spruce had been destroyed on several square miles of forest land. At the time this situation was reported, the severity of the outbreak had started to subside, which made control measures unnecessary. As in most all forests of this type there was a rather severe killing of alpine fir by the western balsam bark beetle (Dryocotes confusus Sv.).

During subsequent years light, so-called normal losses of mature spruce occurred in all spruce stands under observation (6,7). This condition existed until 1934 or 1935, when a rather general outbreak of the Engelmann spruce beetle occurred throughout the northern Rocky Mountains. During this period severe losses of spruce occurred in the northwest corner of the Yellowstone, where a large percentage of the trees on thousands of acres were killed (21,26). In some portions of the infested area practically every tree was attacked and killed, while in others the loss was lighter. So severe was this infestation that it would be safe to place the loss for the entire area at approximately 75 percent of the spruce trees above 10 to 12 inches in diameter. Although the dead trees created a severe fire hazard, the stand will in a relatively few years be restored to its former scenic value from the understory of small spruce trees.

Insect - Mountain pine beetle (Pendroctonus monticolae Hopk.)

Hosts - Whitebark pine, lodgepole pine

Locality - All pine stands

In 1925 several spots of active mountain pine beetle infestation were recorded in whitebark pine on Mount Washburn, which had apparently started some two years previous (6). At the same time a few groups of infested trees were recorded in the Sylvan Pass area. As the infestation on Mount Washburn threatened the destruction of scenic timber stands along an arterial park highway, control measures were instituted and 75 infested trees treated in the spring of 1926 (7). This work was recorded as successful, for a subsequent examination later in the season showed only 4 newly attacked trees, while the status of the Sylvan Pass infestation remained unchanged. In 1927 it was reported that the infestation in both the Mount Washburn and Sylvan Pass areas had died out, or at least returned to a normal status (8).

About this time considerable apprehension was felt as to the danger of the severe mountain pine beetle infestation within the lodgepole pine stands of adjacent National Forests of Montana and Idaho spreading into the scenic timber stands of the Yellowstone. To meet this possibility plans were made to keep all pine forests of the Park under annual observation to be forewarned of dangerous situations. To obtain information concerning the general situation within the Park, an aerial survey was made in 1930 (17). Although this survey did not reveal any alarming situations, only "red tops", or trees attacked the previous season, could be recorded. Later in the season newly infested lodgepole pine were reported from the Bechler River district (28). This condition indicated that the severe infestation of the mountain pine beetle which was present within the adjacent Targhee National Forest, and against which control measures were being directed, had spread into the National Park. Plans were made immediately for the treatment of this infestation in the spring of 1931 (29). This operation (31), which covered some 12,000 acres on which 2,888 trees were treated, was considered successful, as later in the season only a few new attacks were recorded on the treated area. The success of this operation was of course dependent upon the treatment of the source of reinfestation on the Targhee Forest, for otherwise the Park area would have been reinfested.

A second aerial survey of the Park was made early in the summer of 1931, and a number of rather serious insect infestations recorded (18). A ground reconnaissance followed the aerial survey and confirmed the fear that an infestation of the mountain pine beetle, which varied from .04 to 2.3 trees per acre, was present in most whitebark pine areas. During subsequent years additional ground surveys were made, which provided a rather complete history of the "build-up" and "decline" of this destructive outbreak (4, 23, 24, 30, 32, 35, 36).

This infestation, which was confined primarily to whitebark pine, increased in severity and spread over large areas. Its maximum destructiveness was reached in 1938, although in 1940 heavy losses of whitebark pine were still occurring in some areas. At the present time there are only a few scattered infested trees to be seen.

As original timber volumes are not available, it is almost impossible to estimate the total volume of whitebark pine destroyed during the course of this epidemic. Many thousands of trees were destroyed which in some areas will amount to 75 percent of the trees above 6 inches in diameter. Although it was feared that this infestation would work itself out of whitebark pine and spread into the more scenically valuable lodgepole pine stands adjacent, this did not occur. Many lodgepole pine trees were killed, but for the most part they were individuals growing in association with groups of infested whitebark pine. There were also some lodgepole pine losses in the southern portions of the Park, but this situation never reached epidemic proportions.

As this destructive infestation was confined to whitebark pine areas, which were largely remote from tourist travel, the institution of artificial control, which would have involved tremendous sums of money, was not considered as being justified. One exception to this position was the Mount Washburn area, which is traversed by regular Park highways. In an effort to protect the scenic values, control measures were instituted again in 1933, with a follow-up operation in 1934 (31, 34). Although this operation did not eliminate the infestation from this area, it effectively reduced the subsequent damage, which is quite evident when comparisons with other areas are made.

In 1935 it was discovered that the mountain pine beetle had spread into the limber pine areas around Mammoth from the severe whitebark pine infestation a few miles to the southwest (4, 10, 11, 37, 38). Control measures were instituted and continued each year until 1939, when there was no further reinfestation of the treated area. During this period of control 222 limber pine trees were treated, which depicts the annual flights of beetles into the area. This project successfully protected most of the timber stand of the area by preventing the development of local epidemic conditions.

It is true that lodgepole pine trees on utility areas were treated which harbored attacks of the mountain pine beetle. Although some of these attacks were no doubt primary, most of them were secondary to other factors.

1925

Insect - Western balsam bark beetle (Dryocoetes confusus Sw.)

Host - Alpine fir

Locality - All alpine fir stands

Although previously reported in connection with the Engelmann spruce beetle infestation on Frank Island (2), a more extensive examination of the Yellowstone forests showed severe losses in all alpine fir stands (6, 7, 8, 12, 23). This was not considered as an abnormal condition, as the loss of mature alpine fir trees is but a process in the natural cycle of this forest type. Alpine fir is a dominant, primary tree species which succeeds itself. When old, decadent, mature trees are killed by insects, they are replaced from the dense understory which exists in all forest types of this character. The red foliage of dead trees can be seen in all mature alpine fir stands, which in no way detracts from the scenic values of the area in question.

Artificial control measures were directed against an outbreak of the western balsam bark beetle at Duck Lake in 1929. As an outbreak of this insect threatened to destroy the scenically valuable alpine fir stands of that area, control measures were instituted and some 400 trees treated (16). This operation was quite successful, as an examination the following season indicated a 92 percent reduction in the severity of the infestation (17). Maintenance control was conducted in 1930, which apparently restored normal conditions, although there were a few scattered trees in the general area in 1931 (18).

Subsequent detailed surveys of the Park showed that in some areas a large percent, often as high as 50 to 60 percent, of the alpine fir had been killed during a period of a few years.

1925

Insect - Secondary bark beetles

Host - Lodgepole pine

Locality - All Park utility areas

Considerable attention was directed to the dead and dying trees around the many geyser formations and utility areas, with the idea of preventing subsequent losses (6, 7, 8). Many of these trees had been attacked by different species of bark beetles; however, in only a few instances was their attack considered as primary. Around the geysers and hot springs the death of these trees was attributed to the unfavorable and often impossible environment under which they had been growing. In campgrounds the removal of normal forest floor debris, the packing and erosion of the soil from tree roots, injury to roots and bole by automobiles, as well as other factors associated with "Tourist kill", create conditions under which lodgepole pine trees can not survive (15, 16). It is true that these weakened and dying trees were often attacked by such secondary bark beetles as the Oregon pine engraver (Ips oregoni), Monterey pine engraver (Ips radiatus), lodgepole wood engraver (Pityogenes knesteli), Ips latidens Lec., Orthotomicus saclatus Mich., Hylurgops rugipennis Mann., as well as the mountain pine beetle and lodgepole pine beetle. In a few instances these insects were primary in their attacks and killed healthy trees, and in other

instances their attacks may have hastened the death of the tree by a year or more. Although many of these trees were treated, the entomological significance of the beetle attacks as well as the prevention of subsequent losses was thoroughly understood. As for sanitary and safety reasons, it was considered necessary to remove dead trees from campground areas, it was planned to remove and dispose of all infested trees prior to the emergence of the beetles. By keeping the population of these so-called secondary beetles as low as possible it was hoped that the more lightly injured trees might be spared (16, 18). It was also recommended that steps be taken to alleviate the physical injury to all campground trees in the hopes that some of them could be preserved (15). No action was taken and the present status of the campground areas is mute evidence as to the effects of "tourist kill" and the ineffectiveness of directing artificial control against secondary agencies.

Many dead and dying trees which had been attacked by bark beetles were removed from along highways and geyser formations. This action served the twofold purpose of disposing of unsightly dead trees and preventing the development of abnormal populations of secondary bark beetles, which then become primary in their attack (6, 7, 8). In connection with this work its rather futile entomological advantages were fully understood (15, 16, 18). In 1933 an epidemic population of the lodgepole pine wood engraver (*Pityogenes knechteli*) which developed from breeding in weakened trees and some windfalls attacked and destroyed large numbers of apparently healthy and resistant trees between Obsidian Cliff and Madison Junction (34). Control measures were instituted in the spring of 1934, and 10,244 of these rather small trees were felled and burned (3). In some places this loss amounted to a 100 percent destruction of rather large spots of good-sized reproduction. The occurrence of such sporadic epidemics is not an unusual habit of this insect; however, fortunately such outbreaks are of short duration.

In 1937 the previously adopted policy of treating decadent trees in utility areas which harbored attacks of secondary beetles was subjected to further consideration (20). The desire of National Park officers to allow dead trees to stand in campgrounds until they became a potential source of danger placed the two policies in direct opposition to each other. As it had been fully appreciated that there was but little permanent entomological value to be gained from the treatment of these trees, it was recommended that the past policy of insect control in utility areas be discontinued.

1925

Insect - Wood borers

Host - Rustic buildings and furniture

Locality - Mammoth Camp

A desire to have park buildings conform to their natural surroundings resulted in the use of unpeeled logs (6). As many species

of wood borers attacked these logs, the dust from their boring resulted in considerable annoyance to tourists, as well as causing an unsightly loosening of the bark. The use of peeled logs was recommended as a means of eliminating this trouble.

1926

Insect - Lodgepole pine beetle (*Dendroctonus murrayanae*)

Host - Lodgepole pine

Locality - West Yellowstone

A few rather light scattered attacks of this insect were recorded in the vicinity of West Yellowstone (7). These attacks were considered as having been induced by recent cutting of lodgepole pine associated with the constructing of a boundary fence. Attacks of this insect are usually secondary and do not by themselves usually kill trees.

1926

Insect - Lodgepole pine bark weevil (*Cylindroconturus* sp.)

Host - Lodgepole pine

Locality - Old Riverside Ranger Station Area

A number of small lodgepole pine from 1½ to 3 inches in diameter were recorded as having been killed by this insect in 1926 (7, 8). The dead trees occurred as scattered individuals throughout the areas previously injured by sawfly and needle tier defoliation.

1926

Insect - Spruce budworm (*Cacoecia fumiferana* Clem.)

Host - Lodgepole pine

Locality - Bechler River District

An insect defoliating lodgepole pine in the Bechler River District was identified as the spruce budworm (1, 2, 5, 15, 16, 17, 28). It was estimated that this outbreak, in which a large number of trees died as a direct result of the defoliation (2), covered some 75 square miles of lodgepole pine. This outbreak, which must have started in 1926, continued unabated until 1932, when a marked decrease in the severity of the infestation occurred. The following season the outbreak was reported as having practically disappeared (3, 4). There was no further evidence of this infestation until 1941, when a light infestation appeared. A reexamination in 1942 indicated a marked reduction in the previous season's light defoliation.

Insect - Aphid

Host - Limber pine

Locality - Mammoth Hot Springs

In June 1929 a severe aphid infestation was recorded as having developed on the decadent limber pine trees within the Mammoth campground (16). To prevent any additional injury to these trees, which was feared would prove fatal to many of them, the control of this outbreak was recommended. In this recommendation it was realized that the control of the aphid outbreak was not striking at the direct cause of the injury, which was the result of heavy tourist travel. In combating the aphid infestation, it was necessary to repeat the operation in 1930 and 1932 (17, 18, 33). This action was quite successful in reducing the population of these insects, and the trees showed some recovery through a more normal foliage growth. Although it was realized that unless some action was taken to prevent further "tourist" injury many trees would soon die, it is believed that the control measures conducted contributed to the preservation of many trees. Subsequent to this treatment action was taken to eliminate further physical injury, and although a number of severely injured trees died, many of them responded to this culture and are living at this time.

1929

Insect - Spider mite (Oligonychus amereanus Ewing)

Host - Douglas fir

Locality - Madison River

For a mile or more below the Madison River bridge between West Yellowstone and Madison Junction the trees on the north side of the river were found to be heavily infested with spider mites (16). The boundaries of the infested area extended up the mountain side for a few hundred feet and could be easily determined from the dirty, grayish appearance of the trees. No action was taken, as it was believed that no irrecoverable damage would follow. This outbreak continued for another year or two and then dropped from visual existence (18). No losses followed. A light infestation of mites on a few spruce trees was recorded the same season from along the Old Faithful-Thumb highway.

1930

Insect - Spruce sawfly (Homatimus sp.)

Host - Ingelmann spruce

Locality - Old Faithful area

A few small spruce trees were recorded that were being severely defoliated by the larvae of a sawfly (17). This small spot of infestation dropped from visual existence the following year.

1937

Insect - Douglas fir beetle (Dendroctonus pseudotsugae)

Host - Douglas fir

Locality - Mammoth Hot Springs

During the winter of 1935-36 unseasonal weather conditions caused a severe injury to the foliage and terminal buds of forest trees throughout the northern Rocky Mountains. The condition assumed to have been responsible was the abrupt occurrence of unseasonably low temperatures in October 1935 following a long period of warm weather. This injury was quite pronounced in the Madison, Gallatin, and Yellowstone River drainages, where the discolored foliage of the injured trees appeared as broad belts along the mountain sides. There was no uniformity in the location of these areas of winter kill, as they occurred at all elevations and exposures and were believed to have been influenced by air currents.

Presumably as a result of this unseasonal weather the foliage of the Douglas fir and lodgepole pine trees in the vicinity of Mammoth Hot Springs was severely injured and by midwinter was quite brown (37). This injury to the trees was augmented by the destruction of many terminal buds, which could have been associated with the destruction of the foliage or by the occurrence of freezing temperatures in May 1936, which followed a period of warm activity temperatures. Regardless of the cause, the trees were left in a badly weakened condition. However, only a few of them died as a direct result of this injury, for through the development of adventitious buds sufficient foliage was provided for the necessary functions of transpiration.

During August 1937 it was found that the Douglas fir beetle had attacked a number of the larger trees and that a potentially serious epidemic existed. To protect the valuable scenic timber stands of this area control measures were instituted in the fall of 1937, and some 306 trees treated. Follow-up work was conducted in 1938 and 1939, which marked the end of this outbreak. (10, 11, 22, 25, 27, 39).

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